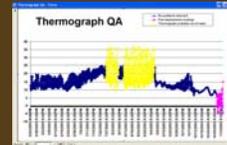
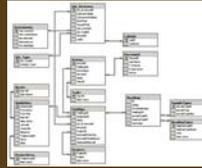


# Implementing an Enterprise-wide Environmental Data Management System

Dan Haug, GIS Manager, CTUIR

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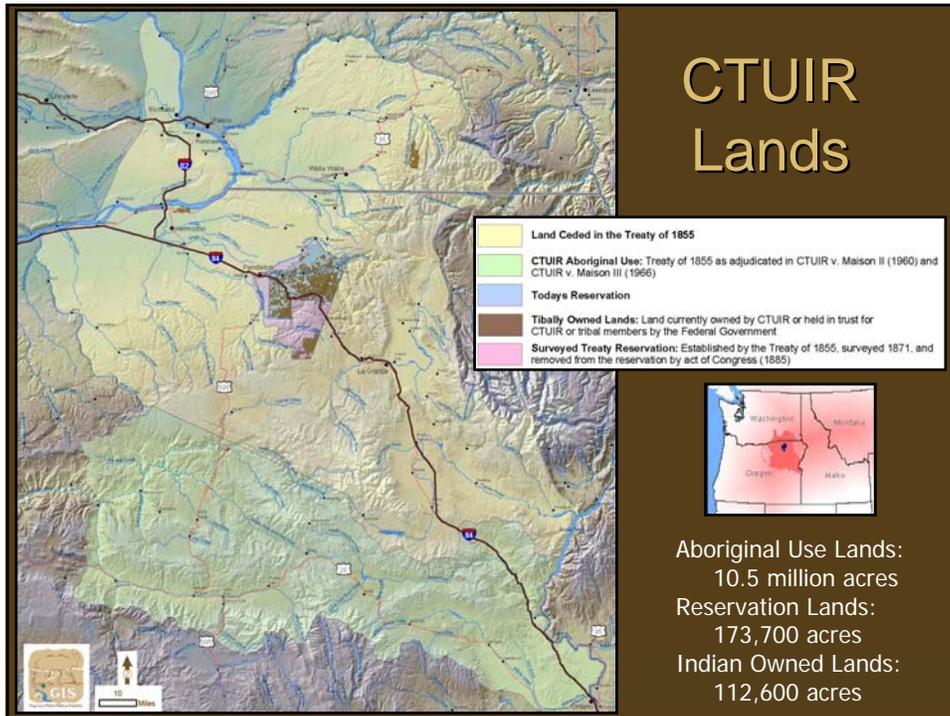
Confederated Tribes of the Umatilla Indian Reservation

## Outline

- Introduction to CTUIR
- Identifying goals and problems
- Implementing solutions
- Discussion



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## CTUIR Community

- Cayuse, Umatilla, and Walla Walla Tribes
- 2,400 Tribal Members
- >1,000 Employees in government and enterprises
- Rapid growth in past 10 years

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## Setting the Context

- **Goal: Creating Informed Policy**
  - CTUIR has 'treatment as a state' status with approved Water Quality Standards
  - The Tribes need to improve capacity to manage these standards
- **Data Management**
  - CTUIR has 10 years of water quality data, and continue to collect significant quantities every year
    - Data collected by different programs throughout the tribe
    - Data maintained in spreadsheets on individual PCs
  - These data need to be applied to the process of policy management



## Proposed Solution

- Construct a centralized Water Quality Database that includes the following:
  - Flexible Data structures
  - Custom applications for entering and accessing data (user interfaces)
  - Administrative structures (QA and metadata)



## Steps For Accomplishing Goals

- Design and implement data structure
- Compile and document disparate data sets
- Build targeted user interfaces to meet specific needs of data producers
  - Data entry (automated QA)
  - Data query and reporting
- Build more general tools for policy makers and the tribal public

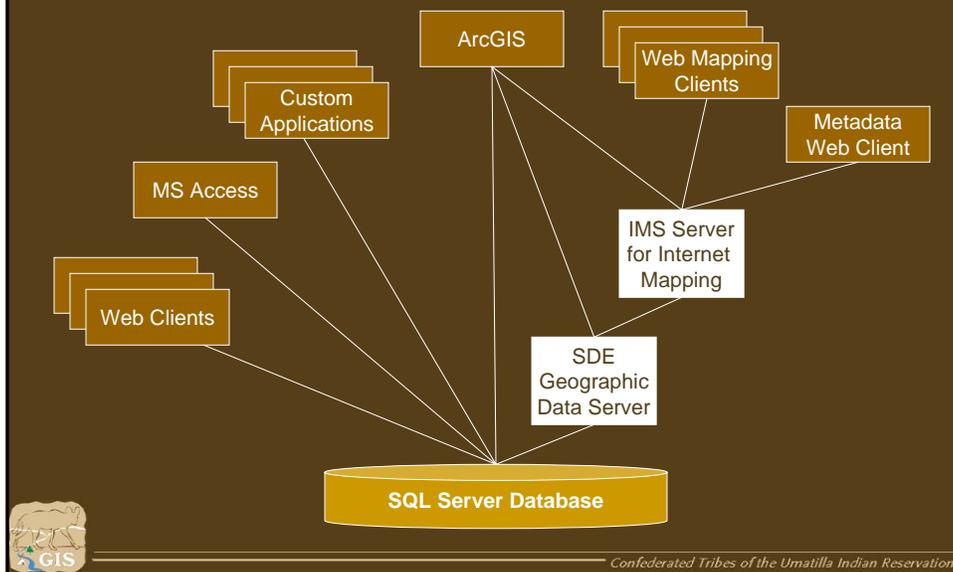


## System Architecture

- **Enterprise Relational Database**
  - Management Software (RDBMS) houses tabular, vector geographic, and possibly raster data
- **Client software**
  - packages access data (HTML, Visual Basic, JAVA, MS Access, ArcMap... etc.)



# System Architecture

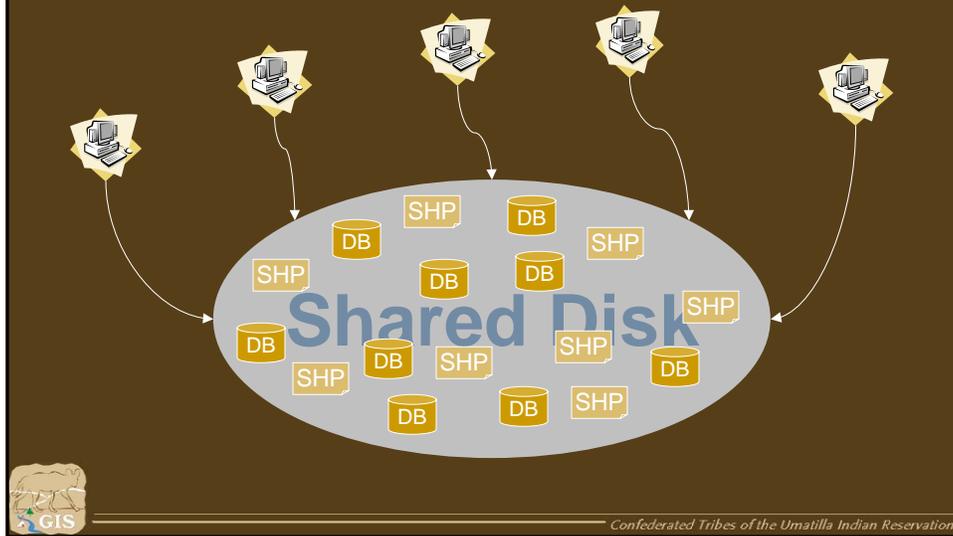


## The Database (RDBMS)

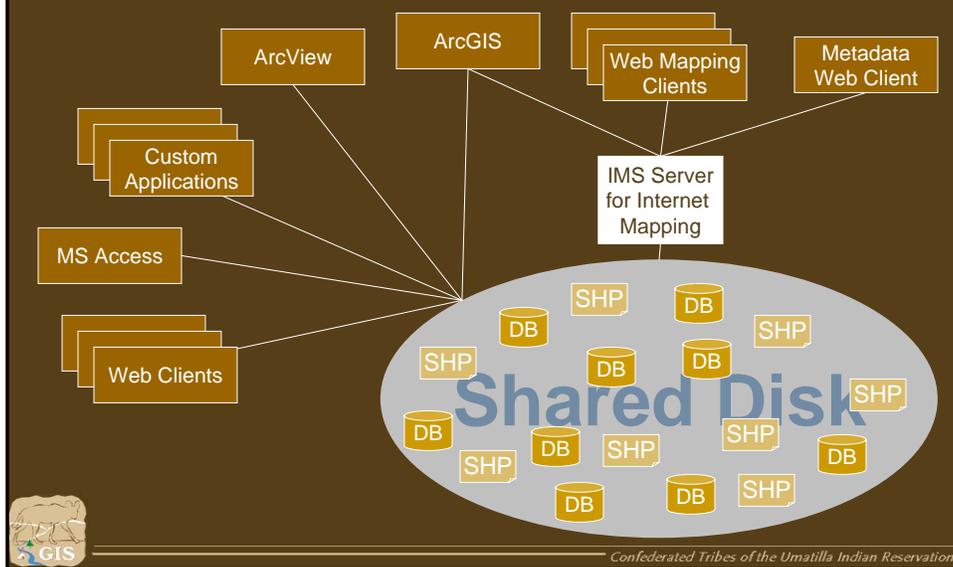
- A single database that can be used to integrate all of the Tribe's existing water quality data and will support the addition and maintenance of data.



# Catalog and Collect Existing Data



# Interim Architecture

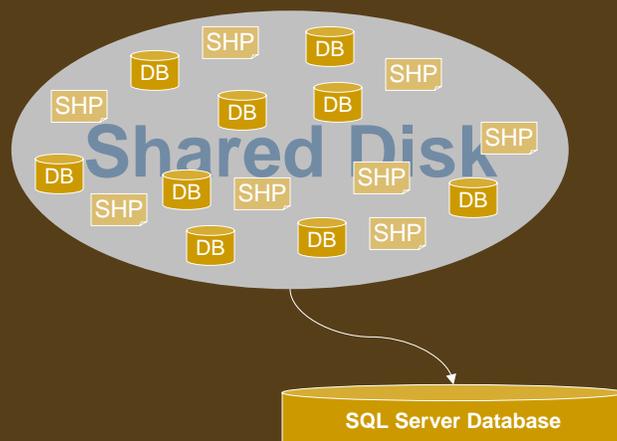


## Interim Architecture

- This interim data structure supports much of the functionality of the final data structure
- Geographic data is available for daily use through layer files (they point to the current data location)
- Prototype custom clients have been written, so they can be easily adapted to the new RDBMS

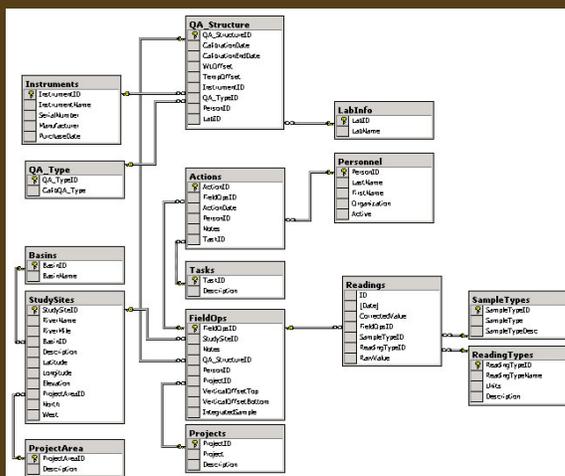


## Load Data



# Data Structure

- Point sample data



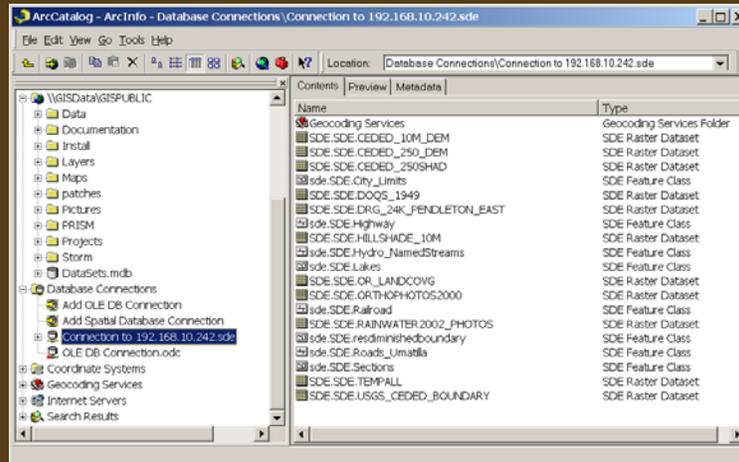
# Spatial Database Engine (SDE)

- An ESRI product that allows GIS data to be stored in the RDBMS and served directly to client software.

SDE  
Geographic  
Data Server



# Spatial Data



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## Internet Map Server (IMS)

- An ESRI product that allows GIS data to be streamed directly to the internet, as well as other third-party clients.

IMS Server  
for Internet  
Mapping



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## Easy to administer web services

- Once you get it running, it's easy to put up multiple maps on the intranet



## Metadata Web Client

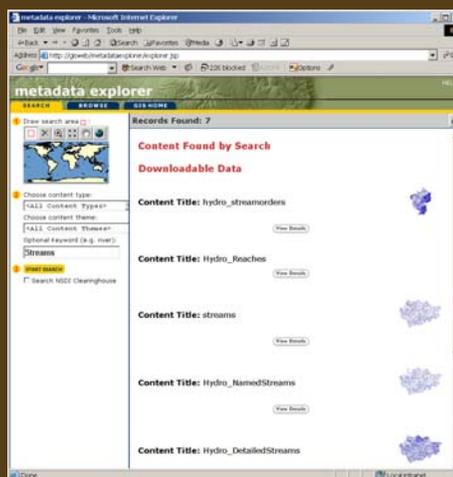
- IMS can provide a metadata service that will serve as a card catalog for our data. This service can be accessed through a web client that will allow users to search for data by spatial location and/or key words.

Metadata  
Web Client



## Searchable Data Index

- CTUIR Staff need to know what data we have



## Web Mapping Clients



- Web mapping clients are custom web pages that can make specific maps using data provided by IMS Server. These clients can be written in HTML, VB Script, Java Script, Java, and many other languages.





# Access control

The screenshot shows a Microsoft Internet Explorer browser window displaying the 'E-coli Data Entry Form'. An 'Enter Network Password' dialog box is open, prompting for user name and password. The form fields are as follows:

- Location: -- Select a Location --
- Personnel: Adam Lipschultz
- Lab Name: BOR - Boise, ID
- Lab Tech: Unknown Lab Technician
- Analysis Date: mm/yy/yyyy
- Lab Sample Point Name: [Empty]

Collection Date/Time	E. Coli Organisms Count / 100 ml	Total Coliform Organisms Count / 100 ml	Field notes (Optional)
mm/dd/yyyy 00:00			

Important: Only numeric values can be entered into the "E. Coli Organisms" and "Total Coliform Organisms" fields. Characters such as "/" or letters will create errors and your data will not be updated to the database.

For values of >2419 use 2419 and this will be assumed to be the maximum and above. For values <1 use 0. Record the absence of ecoli by entering a zero in the data entry form. If a field (such as "Total Coliform Organisms") does not have a value, leave the field blank. Zeros are treated differently than a null value when data is analyzed.

Submit Data

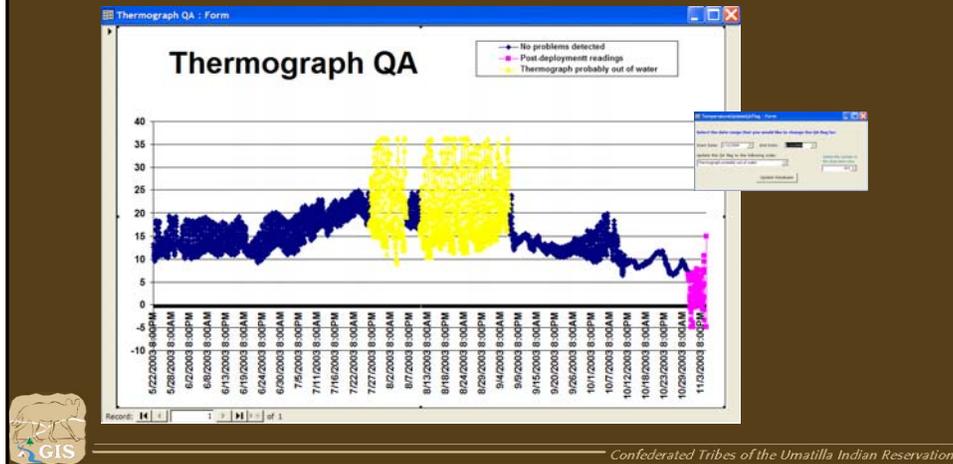
# Microsoft Access

- MS Access can be used as a front-end for more advanced users to query and analyze the data in the RDBMS. It can also be used to extract data sets for analysis in other software packages, such as Excel.

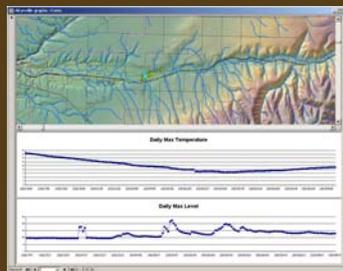
MS Access

# MS Access user interfaces

- Tools for data query, visualization, and quality assurance can be quickly developed in MS Access

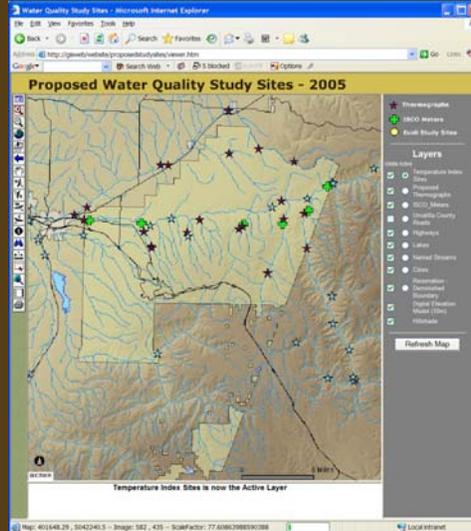


# MS Access and ArcObjects



## Intranet access data-driven maps

- Providing access to data to non-technical staff and elected officials



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## ArcGIS

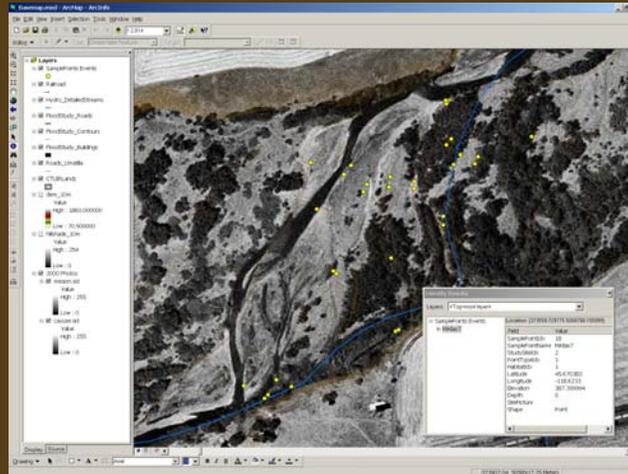
ArcGIS

- ArcMap can access data directly from IMS, SDE, and the RDBMS.



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## ArcGIS can act as a client



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## Stand-Alone Clients

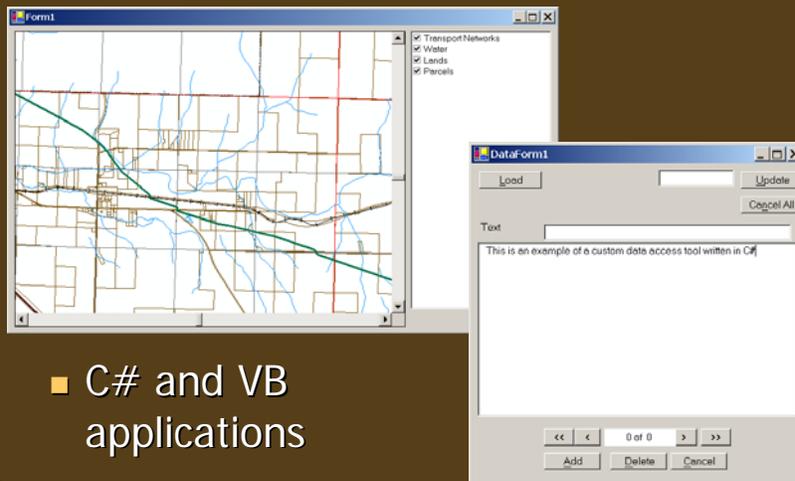
Custom Applications

- Custom applications to access and edit the data in the RDBMS can be written to serve the specific needs of different users and uses. These applications can be written in Visual Basic, Java, C#, and other languages.



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## Custom Stand-alone Tools



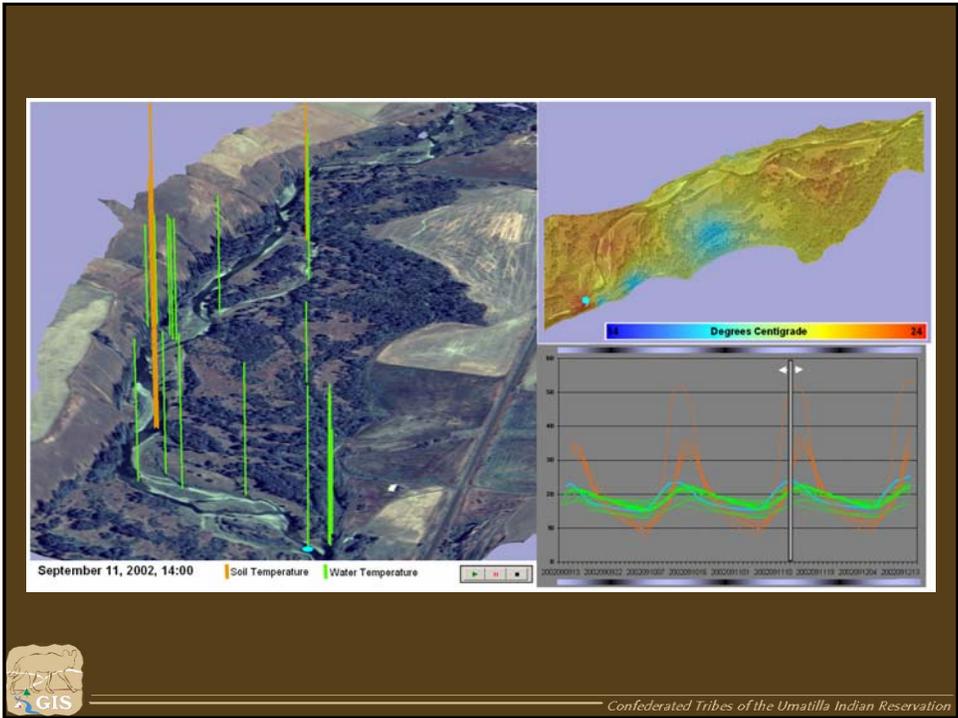
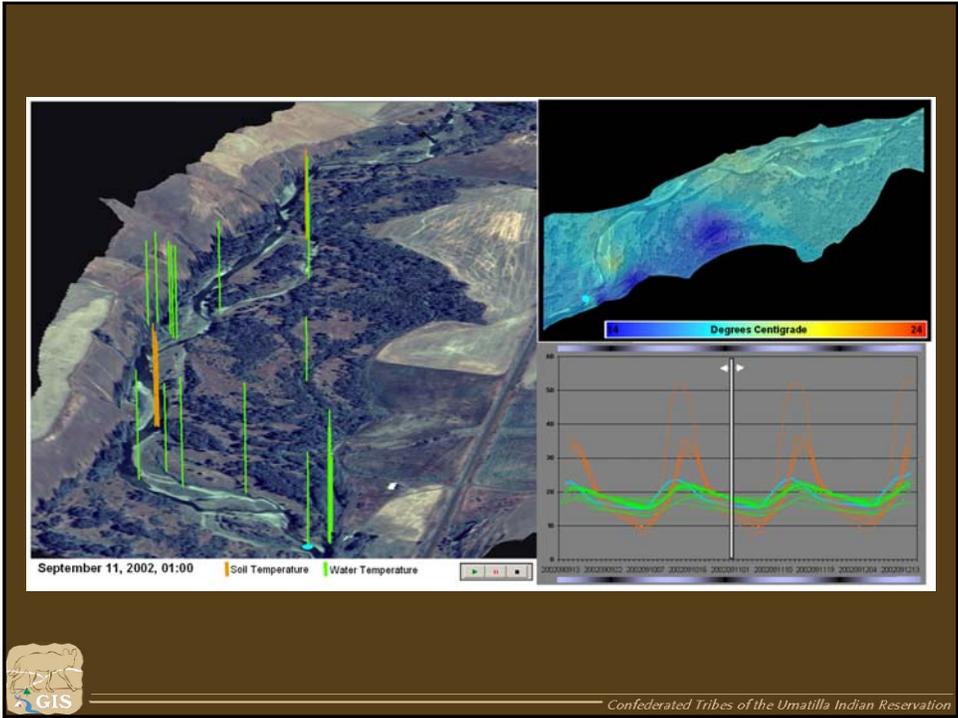
- C# and VB applications



## Future Work

- Creating an internet site to share water quality data
- Creating custom visualization tools for interactive QA and exploratory data analysis
  - Linked representations of data





## Points to Ponder

- Cooperation was achieved with a carrot rather than a stick
  - We offered data producers solutions rather than rules
- The technical architecture is as much a part of the solution as the standards and protocols
  - Conceptual goals are based on beliefs of what is technologically possible
- Continued technological support is the key to continued success
  - System maintenance and extensibility

